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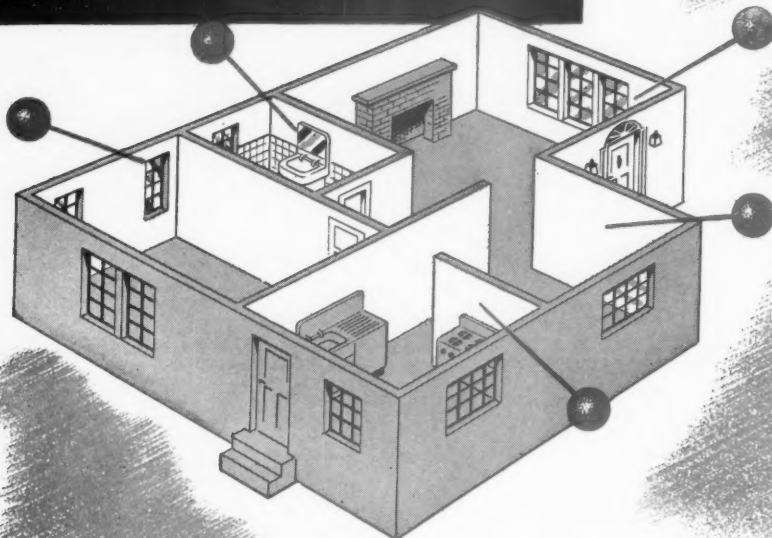
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REPORTS ON SOME EXPERIMENTS WITH WHITE PAINTS AND VARNISHES CONTAINING OIL OR SUBSTITUTES

By DR. FELIX WILBORN

The following is a condensed report on four long-term experiments conducted for the purpose of determining the extent to which linseed oil or other drying oils can be replaced by other vehicles. Most of these experiments were carried out in Germany during the last war when oil became one of the chief problems. It is obvious, therefore, that no efforts were spared to develop paint and varnish recipes ensuring durable paint and varnish applications on wood surfaces and it is equally significant for this particular reason that in spite of all the efforts of the then highly developed German paint and varnish industries the results of our experiments were less satisfactory than expected from previous indications. Our report will show, in any case, that most of our comparative experiments extending over a number of years and under various conditions proved the absolute superiority of the oily mixtures. It was found that wherever linseed oil or one of the other standard drying oils were replaced with substitutes the durability of the impregnations and films was lowered. The only positive result obtained with the observation that superpolyamide resin solutions formed a satisfactory and durable wood impregnation.

The first problem to be solved by us was whether we could possibly get along without the usual impregnation of wood surfaces with linseed boiled oil, substituting the latter with some oilless impregnating mixture or if we would have to retain the usual priming with linseed boiled oil and to use an oilless intermediate coating. A third alternative was to employ oily priming and

intermediate coatings and oilless top coats, but this alternative was not considered promising and was finally ignored altogether.

The ideal suitability of linseed boiled oil for the impregnation of wood surfaces depends to a large degree on its low degree of viscosity and its low molecular gravity ensuring deep penetration in most types of wood. It is one of the most important requirements of modern wood impregnations that if the surface of the film or wood is scratched or otherwise damaged the impregnating substance must have penetrated sufficiently deep to form a dense layer beneath the surface film and thoroughly impervious to water, etc. Even the smallest pores must thus be filled up in order 1) to prevent moisture from entering the wood from the outside through damaged areas of the film, and 2) to prevent the moisture within the wood from reaching the film from the rear.

In spite of the low initial molecular gravity of linseed boiled oil it grows considerably after film formation. The film also absorbs a certain amount of water which far from being a disadvantage really is very beneficial to both the wood and the film. The wood itself is quite hydrophilous. If, now, the wood is covered with an entirely impervious film and if outside moisture penetrates through pores (present in all films) down to the wood fibres, these are bound to swell and to exert a considerable pressure on the films. Since entirely impervious films are non-swelling they are then forced away from the surface of the wood.

O. Jordan, Ludwigshafen, was able to prove that the weather resistance of nitrocellulose lac-

quer films on wood could be improved if the hydrophobic plasticizers contained are substituted with suitable water-soluble substances.

Linseed boiled oil films are very elastic and pliable, enabling it to follow all movements of the wood. All these reasons prove the unic suitability of linseed boiled oil for wood impregnation, and we realized beyond doubt that all painters and wood workers would very much prefer to use an oilless intermediate coating rather than an oilless primer. Another plausible reason for this preference was that oilless impregnations of wood with materials compounded on a nitrocellulose basis had proved quite satisfactory for indoor work but entirely unsatisfactory for outdoor application.

Our four series of experiments were planned as follows:—

- 1) Impregnation with linseed boiled oil, oilless intermediate coating and oily top coating.
- 2) Various oily and oilless impregnations, oily alkyde resin intermediate coat and alkyde resin top coating.
- 3) Polyvinyl acetate of low viscosity for the impregnation of wood.
- 4) Use of emulsion paints for intermediate coatings.

1. Series

Pine wood panels selected for maximum uniformity were impregnated with a mixture consisting of 90 parts by weight of linseed boiled oil and 20 parts of white spirit. Application was plentiful, the excess being wiped off after a considerable time. The intermediate coatings were applied one day later, the top coatings four days later.

Results:—It is impossible to offer a detailed review of the behaviour of the 25 different types of coatings. We will gladly supply all the various compositions on application but must restrict our present deductions to a description of the most and least favorable coatings applied in our tests, which extended during 13½ months.

By far the worst of all coatings proved to be an intermediate film made from a polyvinyl acetate mixture containing 170 parts of Mowilith-N solution, 40 parts titanium dioxide, 20 parts of sachtolith and 20 parts of zinc-white (green seal).

This film had blistered considerably after only 7 weeks of exposure and started to come off in large sections 7 months after application. Another intermediate coating consisting of 100 parts Plexigum (40% solution of Plexigum in xylol), 24 parts butyl bezyl phthalate, 30 parts talkum, 16 parts zinc white (green seal) 15 parts titanium dioxide, 15 parts sachtolith and 30 parts xylol developed similar faults after seven months of exposure.

After 13½ months of exposure only the following two intermediate coatings proved to be entirely faultless:—

No. 172	No. 183
Alkyde resin mixture	Acid-hardened urea resin
100 pts. special vehicle	120 pts. Plastopal AT
1.5 " flotation agent PV	50 " Plastopal CB
50 " zinc white	30 " titanium dioxide
(green seal)	30 " titanium white
50 " titanium dioxide	Standard T
20 " white spirit	Previous to application
The "special vehicle" used	this paint is mixed with 23
in this recipe is the one	parts of a 20%-solution of
employed in the top coating	concentrated hydrochloric
applied to these panels.	acid in ethyl acetate.

The top coatings applied on these and all other intermediate coats tested in this series were made up as follows:—

100 parts	Special vehicle (see below)
60 "	zinc white (green seal)
10 "	titanium dioxide
1 "	alpha-crotonic acid (Spreading agent)
25 "	white spirit

The "special vehicle" used in this and other mixtures was composed as follows:—

75 parts	alkydal T-solution with 60% of white spirit
15 "	AW 2 resin solution (cyclohexanon resin)
	50% sol. in toluol
6 "	white spirit
2.5 "	ethyl glycol
1.5 "	siccative.

The fact that the test No. 183 came out best proves the advantage of acid-hardened urea resins over the physically drying urea resins, all paint samples composed on this basis having proved unsatisfactory. This difference can be explained with the observation that the physically drying urea resin compositions develop a much higher degree of brittleness without getting as hard as the acid-hardened films, causing the top coatings to "float" on the intermediate coats. The same fault seems to explain the unsatisfactory behaviour of the polyvinyl acetate combination mentioned above, although another intermediate coating made up on this basis but containing more titanium dioxide and zinc white (green seal) yielded somewhat better results.

2. Series

In this series of tests conducted to determine the behaviour of different impregnating substances we used identical intermediate and top coats for all panels, i.e. the intermediate coat No. 172 described above, which proved highly satisfactory in the first series of tests, and the top coating described above which had also been used for all tests of the first series.

All the panels were prepared and placed into their racks on building roofs in July. Inclina-

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tion:—45 degrees toward South. The same inclinations and directions of exposure were maintained in all tests of the four series.

Results:—This second series of our tests proved that the panels impregnated with linseed boiled oil were the only ones yielding perfectly satisfactory results. In fact these panels were the only ones which after 13½ months of exposure remained practically faultless.

Unsatisfactory results were obtained with nitrocellulose lacquer impregnations. Compositions of this type are much better suited as intermediate coatings. Much better results were obtained with acid-hardening urea resin varnish (Plastopal H + 30% thinner and acidified before application with 10 percent of a 20% solution of concentrated hydrochloric acid in ethyl alcohol). These films had developed only a few extremely fine haircracks at the edges of the panels. The same applies to an impregnation with alkydal-T solution and to a super-polyamide resin solution (60 pts. Igamid BL-40 in 180 pts. ethyl alcohol + 30 pts. water + 30 pts. ethyl glycol). All these applications developed only isolated thin hair cracks after 13½ months of exposure, although none of them equalled the plain linseed boiled oil impregnation.

Worst results were obtained with a physically hardening urea resin varnish consisting of plastopal W-50-B + 10% ethyl acetate, this panel exhibiting large cracked-off areas even after 7 months of exposure, while at the end of the testing period more than 30 percent of the film had cracked off. Practically as bad as a panel impregnated with a polyacrylic acid ester solution which was cracked in all direction, most of these cracks having widened by the rolling up of the films. Another very unsatisfactory composition proved to be an acetaldehyde resin varnish consisting of 175 pts. Wacker shellac P-120, 136 pts. ethyl alcohol and 29 pts. tricresyl phosphate.

Considering all these results we were forced to conclude that if either the priming or intermediate coating must be oilless, it is preferable to impregnate with oily material and use oilless intermediate coatings, many of which have proved highly satisfactory (including the nitrocellulose lacquer combinations) if they are applied on oily priming coats. Indeed, we have found that the panels provided only with intermediate and top coats (without impregnating priming) stood up quite as well as any of the panels provided with the best oilless impregnation coats.

3. Series

This third series, while not originally planned, was conducted exclusively with polyvinyl acetate of low viscosity as impregnating priming substances. We had obtained relatively good results with such impregnating mixtures and supposed that we could still further improve them with Mowilith-15, a product of the I. G. Farbenindustrie, characterized by a still lower degree of viscosity, which was supplied in 60 percent solutions. The series comprised five tests, three of them with

the Mowilith samples containing differing percentages of ethyl alcohol, one with straight linseed boiled oil, and one with linseed boiled oil thinned with equal amounts of white spirit. Intermediate and top coats as in the first and second series.

Results:—All samples proved satisfactory after 10¾ months of exposure. There were slight cracks and a few hair cracks even in the sample impregnated with straight linseed boiled oil, best results having been obtained with the linseed boiled oil solution with white spirit which remained practically faultless throughout the entire period of exposure. The quality of the polyvinyl acetate impregnations improved directly with the degree of thinning, the panel impregnated with 133 pts. Mowilith + 67 pts. ethyl alcohol standing up much less satisfactory than those impregnated with a mixture consisting of 67 pts. Mowilith + 133 pts. ethyl alcohol. Further tests showed however that under different conditions of application and exposure impregnation with polyvinyl acetates behaved less satisfactory.

4. Series

The fourth series of tests was conducted with emulsion paints as intermediate coatings. Impregnations were effected 1) with linseed boiled oil, 2) with superpolyamide resin solutions, and 3) with a polyvinyl acetate solution (the 60% Mowilith-15 solution containing 80 pts. ethyl alcohol) found satisfactory in the third series of tests. The top coatings consisted of the alkyd resin paint employed in the three first series.

Two types of emulsion paints were used:—

- 1) *Polyacrylic acid resin emulsion*
 150 parts Acronal 430-D
 120 " Water
 75 " Titanium dioxide
Polyvinyl acetate emulsion
 100 parts Mowilith-D.300
 6 " Collacral-N
 100 " Water
 75 " Titanium dioxide

In order to obtain reliable comparative results two alkyd resin paints were used as intermediate coatings, i.e. the alkyd resin paint No. 172 applied in the first series of tests, and another mixture similar to No. 172 but containing 100 pts. each of titanium dioxide and white zinc and 50 pts. of white spirit.

The following table indicates the scope and variation of the tests of the fourth series:—

Panels	Impregnation	Intermediate Coating
No.		
262	Linseed boiled oil	Alkyd resin paint
262a	"	alkyd resin paint less oil
263	"	polyacrylic acid resin emulsion
264	"	polyvinyl acetate emulsion
265	Superpolyamide resin solution	alkyd resin paint
265a	"	alkyd resin paint less oil
266	"	polyacrylic acid resin emulsion
267	"	polyvinyl acetate emulsion
268	Polyvinyl acetate solution	alkyd resin paint
268a	"	alkyd resin paint less oil
269	"	polyacrylic acid resin emulsion
270	"	polyvinyl acetate emulsion

271	No impregnation	alkyd resin paint
271a	"	alkyd resin paint less oil
272	"	polyacrylic acid resin emulsion
273	"	polyvinyl acetate emulsion

The panels were closely inspected 2 weeks, 2 months, 1 year and 2 $\frac{1}{4}$ years after commencement of exposure.

Results:—The emulsion paints are not as well suited for intermediate coatings as the alkyd resin paints, a result which merely confirmed the observations made with the tests on the polyacrylic acid resin paints and the polyvinyl resin paints as intermediate coating conducted in connection with the first series of the present investigation. We also observed that this inferiority of the emulsion paints (under the conditions of test selected by us) grew with time. While during the first few months or even during the first year the difference between the alkyd resin paints and the emulsion paints was not so very considerable, destruction of the films containing emulsion paints as intermediate coatings became more and more rapid even where linseed boiled oil was employed as impregnating agent. After 2 $\frac{1}{4}$ years of exposure only the panels Nos. 262, 262a, 265 and 265a were found to have remained satisfactory.

A very interesting observation was that the impregnation of the panels with superpolyamide resin solution proved almost as satisfactory as the impregnations with linseed boiled oil, confirming the respective findings in the first series of tests.

Of similar importance was the unsatisfactory behaviour of the impregnations with polyvinyl acetate solutions, which proved the worst of all impregnations, and the films applied on these priming coats were much more destroyed even than those without any impregnating coating at all (Tests Nos. 271-273). Indeed, after one year of exposure these latter panels with intermediate alkyd resin paints (tests Nos. 271 and 271a) exhibited but small indications of commencing destruction, while at the end of the same period of exposure all the panels Nos. 268-270 had become practically useless. This observation is in direct contrast to the results obtained in the third series of tests. It is quite obvious, therefore, that the suitability of polyvinyl acetate of low viscosity for wood impregnations must still be considered a matter of uncertainty, or rather, it depends upon general conditions including the composition of the polyvinyl acetate mixtures themselves and those of the intermediate and top coats.

Another technically important result of this fourth series of tests was that the intermediate alkyd resin paints containing larger amounts of oil did not prove as satisfactory as those made up with less oil, the panels 262a, 265a, 268a and 271a having been more satisfactory than the respective numbers 262, 265, 268 and 271.

The author begs to point out in conclusion that he is perfectly aware of the fact that the results obtained in all these tests should not be generalized. In spite of the considerable range of the

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testing scheme and the very large number of tests carried out, the results apply only to the conditions selected which at the time in question were determined by the general technical and political

factors prevailing in Germany during 1941, 1942 and 1943. It is believed nevertheless that some of the data determined is of considerable technical usefulness, justifying their publication.

NEW DEVELOPMENTS FOR HIGH STYRENE-BUTADIENE COPOLYMERS PROTECTIVE COATINGS*

By R. E. WORKMAN

The Goodyear Tire and Rubber Company, Inc.

Pliolite S-5 is a resin produced by copolymerizing styrene and butadiene with the styrene monomer predominating. The pioneering resin of its type, Pliolite S-5 has met with outstanding success since its introduction a few years ago. In that time it has become synonymous with the production of high quality durable concrete floor enamels.

The styrene-butadiene resins on the whole do not exhibit the solubility characteristics required for use in protective coatings. In the case of Pliolite S-5 however, the copolymer is so modified that in comparison it exhibits good solubility. The coal tar derivatives and the aromatic petroleum naphthas are excellent solvents for the resin and solutions of Pliolite S-5 exhibit good color and clarity.

Solvents

Such aromatics as xylol, toluol, and hi-flash aromatic naphtha are excellent solvents. These solutions will tolerate dilution with cheap petroleum thinners to about equal parts by weight without precipitation of the resin. This does not necessarily mean that all such solvent mixtures would be satisfactory or that identical solution viscosities would be obtained. Normally, however, dilution is not accompanied by considerable viscosity effect or changes in other properties of the solution. The Kauri-butanol value has been found to be an excellent guide in choosing a solvent for Pliolite S-5. For example, a typical high aromatic naphtha of 78 KB used with a 36 KB mineral spirits gives a good solvent mixture. This mixture has a combined Kauri-butanol value of 60. In designing solvent mixtures for Pliolite S-5, it is well to maintain a proper balance of the evaporating rates so that solvency of the combination does not become progressively leaner or weaker during the drying period. Other solvents for Pliolite S-5 are turpentine and other terpenes, chlorinated hydrocarbons, esters, and ketones, except acetone.

Compatibility

The styrene-butadiene resins are typical of high

molecular weight polymers in that somewhat limited compatibility is exhibited. Drying oils are used to a limited extent when slight modification is required. These include linseed, oiticica, perilla, and tung. Drying oils vary considerably in compatibility. Blowing or kettle bodying materially reduces the compatibility characteristics of any of the drying oils.

Most of the commonly used chemical plasticizers are compatible through all useful ranges. These include Santicizer B-16 and 160, dioctyl phthalate, tricresyl phosphate, dibutyl phthalate, and so forth. As would be expected, the plasticizing effect varies considerably with the different materials. The selection of high plasticizing effect materials for additional flexibility is generally a matter of trial until the proper selection is made.

For a considerable number of Pliolite S-5 applications, the chlorinated paraffins or chlorinated diphenyls are used. Readily compatible, this group of plasticizers is characterized by chemical inertness, good stability, good pigment wetting, and good compatibility.

Drying Characteristics

The high styrene-butadiene copolymers are relatively unreactive. Pliolite S-5 is a non-oxidizing resin, hence dries primarily by solvent evaporation. The resin develops a tack or dust-free stage in a matter of minutes. In most formulations, such as concrete floor enamels, light traffic is permitted in approximately 4 hours. In chemicals resistant finishes, however, forced drying is recommended in order that all traces of solvent are removed. Otherwise, attack or emulsification of the solvent by the chemical may occur and cause premature failure of the film.

Concrete Floor Enamels

Pliolite S-5 is non-saponifiable and therefore gives excellent resistance to the alkalis in concrete. Concrete contains calcium hydroxide which is formed by the hydrolysis of the constituent calcium silicates and aluminates during the hardening process. In sub-surface areas, such as basements, the concrete is frequently wet. As water diffuses through the concrete mass it becomes

* Presented before the Thirteenth Annual Convention of the Southern Paint and Varnish Production Club, Biloxi, Mississippi, March 10, 1949.

saturated with calcium hydroxide and will saponify oleoresinous coatings. Such a film will usually soften and blister or may be completely removed. Pliolite S-5 is not affected by this action and is readily adaptable for concrete coatings.

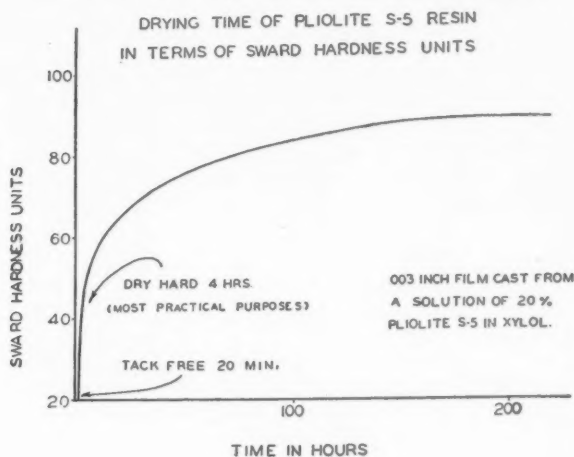


Figure 1

Federal Specifications TT-P-91 describes tests that will vividly illustrate this point. Briefly, the coatings are painted on small concrete blocks, then partially and totally immersed in water. The blocks are then scrubbed with approximately a half per cent solution of tri-sodium phosphate and a fiber scrub brush. Generally the oleoresinous films will be completely removed by 500 strokes of the brush, while a failure has yet to be encountered with Pliolite S-5.

The abrasion resistance of concrete floor paints is one of the main consumer questions. From the consumer's standpoint, this also includes fine mar resistance. The coating should maintain its decorative effect without marring and dirt grinding into the film. These conditions mean, of course, that the base should form hard tough films. Mar resistance, hardness and general wearing characteristics improve on aging.

Chemical Resistant Finishes

The corrosion and chemical resistance of Pliolite S-5 is generally well known. Resistant to 50 per cent caustic, 10 per cent sulfuric, hydrochloric and nitric acids, acetic acid, mineral, and vegetable oils, Pliolite S-5 is the base for many corrosion resistant finishes. The pigments and extenders must be selected with caution inasmuch as these materials must also resist the intended exposure. China clay, carbon black and titanium dioxide are generally chemically inert and are used quite successfully in corrosion resistant finishes. Plasticizers normally employed are the chlorinated products such as the chlorinated diphenyls or the chlorinated paraffins. The main caution in the use of such finishes is that the coating should be a continuous film and be thoroughly dry before complete exposure; the reason for this being that the residual solvent may be

the attacked medium, and hence cause premature failure.

Stucco Points

The basic requirements for stucco paints should be divided into two general classifications: (A) Durability, and (B) Practical or Working Properties. Under durability, the following properties are important and should be achieved with a minimum amount of compromise: 1. resistance to water so that the surface will have less tendency towards moisture absorption, 2. resistance to the alkalis present in the concrete or stucco, 3. excellent adhesion so that the coating will remain on the surface, 4. good sunlight stability in order to prevent objectionable after-yellowing, crazing, etc., 5. properly controlled erosion and chalking to promote self cleaning, 6. ultimate failure must provide a good surface for recoating.

The working properties may be designated as follows: 1. Ease of application by either brush or spray gun, 2. Non-settling and minimum skinning in the container for easy mixing, 3. Good hiding for one-coat covering. The practical properties are important considerations because experience has shown that complaints in this category are perhaps more numerous than complaints of durability. A complaint peculiar to Pliolite S-5 is that of solvent sensitivity. However, with proper solvent balances in combination with correct pigmentation, this disadvantage is minimized.

A majority of the characteristics desirable in

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stucco paints have been demonstrated by Pliolite S-5 in other applications. A consideration of these qualities would suggest Pliolite S-5 for use in stucco paints. The requirements of resistance to alkali, water resistance and good adhesion have been well met in other applications of Pliolite S-5 on surfaces of alkaline reaction.

The problems of formulating for properly controlled erosion and chalk and type of ultimate failure in Pliolite stucco paints are at the present being studied. This work is therefore offered in an experimental nature because 6 months' or a year's exposure, while not showing any indication of deleterious effect, is not an unqualified recommendation as to the merits.

In the development stages it was felt that a major modification of the Pliolite S-5 would be necessary, mainly to obtain a blend with low viscosity plasticizers to give a practical grinding liquid. Another consideration was that suitable modifiers would also tend to lower the vehicle cost. A basis of selection is that any modifier should have good compatibility, stability, non-yellowing properties and alkali resistance—or that it should contribute to, rather than detract from, the desirable properties.

Fortunately, it has been found that the chlorinated diphenyls and the chlorinated paraffins appear to supply these characteristics. Accordingly test vehicles were made as follows: (a) 50 parts of Pliolite S-5 modified with 25 parts of chlorinated paraffin of 40 per cent chlorine content and 25 parts of chlorinated paraffin or 70 per cent chlorine content. (b) 50 parts of Pliolite S-5 with 25 parts of "Aroclor 5460" and 25 parts of "Aroclor 1254."

Stucco finishes are normally pigmented to produce flat or low-sheen semi-gloss paints. The experimental Pliolite stucco finishes were pigmented on the basis of flat finishes. Pigmentation changes alone can definitely effect chalking, dirt collection and after-yellowing.

Quite an exposure series is on test in which both pigment types and pigment volume ratios are varied. Present progress on exposure has given an indication that a pigment volume concentration between 56 per cent to 66 per cent is a desirable range.

A promising development stucco paint formulation is as follows:

Suggested Pliolite S-5 Stucco Formulation

Material	% by Weight
Titanium Dioxide (Non-chalking non-yellowing Rutile)	17.52
Zinc Oxide	5.02
Asbestine	20.02
Pliolite S-5	7.04
Chlorinated Paraffin (40% Cl)	3.52
Chlorinated Paraffin (70% Cl)	3.52
Mineral Spirits	17.92
Hi-Flash Naphtha	17.92
Grind in pebble mill overnight	
Celite (Superfloss)	7.52
Grind two hours	
	100.00

Consistency	71 KU
Total Solids	64.16%

This formulation has been exposed in California, Arizona, Texas and Florida.

From the data accumulated to date, the Pliolite S-5 stucco finishes appear quite interesting.

Pliolite S-5 Plaster Sealers

The problem of providing adequate protection for oleoresinous wall paints on plaster surfaces has been of paramount importance for many years. This need has been accentuated in recent years by the great increase in construction and its required speed. It has been generally realized that plastered walls and ceilings require some form of treatment or undercoating prior to application with oleoresinous paints and enamels. In years past, some recommendations called for an aging period of six months or more before the painting of any plaster surface, and then only after the use of a neutralizing wash solution. In recent years, however, considerable progress has been made in the development of wall finishing systems. Today, a good sealer may be considered an essential part of plaster painting.

The primary requirements of any sealer are, (a) non-saponification, (b) good adhesion to plaster, (c) adhesion of succeeding coats, and (d) non-penetration or good paint holdout.

All plaster, regardless of age, exhibits some degree of alkalinity in the presence of moisture. There is a wide range between low and high alkali plasters and between good and poor plastering techniques. Therefore, to provide a good margin of safety, plaster sealers should have good alkali resistance. Pliolite S-5 fits into this requirement well as it is alkali resistant and forms a practical paint film without the addition of any saponifiable material.

The property of adhesion to plaster surfaces is, of course, an obvious requirement. Any paint coating, to be satisfactory, must adhere to the surface on which it is applied. There is sufficient evidence, both from laboratory and practical tests, to establish Pliolite's excellent adhesion to concrete and plaster-type surfaces.

The good service being rendered by current traffic paints, concrete floor enamels and stucco finishes is at least partly due to the adhesion of Pliolite S-5 to such surfaces. The logical conclusion is that a vehicle made from Pliolite S-5 fits into the picture of plaster sealers on this consideration.

The property of adhesion of succeeding coats or paint anchorage is very important. It is just as essential that the finish coats stick to the sealer as it is the sealer stick to the plaster. However, the matter of paint anchorage is a somewhat different property in that it is not a specific characteristic of the vehicle. It is, on the other hand, more of a formulating problem to produce a sealer which will provide good physical paint anchorage. This is generally accomplished by pigmentation with fairly coarse inerts or ex-

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tenders that give a semi-gloss of flat finish. Such a finish is microscopically rough and promotes good physical bonding. Extenders like asbestine and diatomaceous silica are usually used for this purpose.

Penetration of succeeding coats is the property that has the greatest effect on the initial appearance of the finished wall or ceiling. A good sealer must provide a uniform surface for finish coating because if there are differences in absorption, the enamel or wall paint will show varying degrees of flatness or gloss. Therefore, the sealer, regardless of the plaster or wall condition, should give equal enamel holdout. One point has to do with the degree of penetration of the sealer vehicle into plaster. This influences the amount of binder remaining in the coating and hence the holdout of finish coats. The other factor is the specific enamel holdout of the sealer regardless of the substrate. In the first case, the problem is one of vehicle formulation to prevent too much penetration. It has been found that higher molecular weight vehicles have less tendency toward penetration and therefore bodied or polymerized oils are preferred for sealing properties in general. This line of thought again leads to the conclusion that Pliolite S-5, with its high molecular weight, should make a good sealer.

The other factor of non-penetration, that is, specific enamel holdout, is a somewhat more complicated problem. It involves such properties as solvent resistance, pigmentation, and pigment vehicle ratio. It is self-evident that a sealer would not be very effective if it were completely dissolved by the thinners of succeeding paints, and therefore good solvent resistance is essential. The pigmentation is a formulation problem to develop the hiding and the degree of flatness desired in a pigment-volume ratio that promotes best enamel holdout. Generally speaking, low pigment content tends toward greater holdout but a compromise must be made for the necessary hiding and flatness. There are extenders that are chemically treated for holdout properties while others are ground fine for the same purpose. In short, the final formulation must contain the proper amount of the right pigments for the vehicle in question to produce a satisfactory plaster sealer.

From the discussion so far, it is seen that Pliolite S-5 has many of the properties needed for a good plaster sealer. It is alkali resistant. It adheres to plaster type surfaces. It has high molecular weight for low penetration, and it has sufficient solvent resistance for use under conventional oleoresinous paints. With this background, a project was started for the development of a sealer that could be recommended for use over fresh or old plaster and recoated with any oleoresinous type of paint. Many formulations were tried before arriving at the one which gave the best combination of the desirable properties.

Suggested Plaster Sealer Formulations

Material	% Wt.	No. Per 100 gal.
Pliolite 29908	14.89	136.0
Asbestine	17.05	154.0
Titanium Dioxide	10.63	96.0
Nuomix *	.53	4.8
Mineral Spirits	26.60	241.0
Hi-Flash Naphtha	30.30	275.0
	100.00	906.8

* Nuodex Products Company.

Grind in a pebble mill to North fineness of 3:

43.1% Total Solids

40 Seconds No. 4 Ford Cup

37% Pigment Volume

Ready for Brush Application

As indicated, the grind was made in a pebble mill, but there are no reasons that would prevent production on other type equipment, if so desired.

The formulation of the plaster sealer is submitted with the thought that it be considered as a recommended starting point for development work. No two manufacturers will produce identical lines of interior paints, and it is not unreasonable to assume that their specific requirements for a plaster sealer should be somewhat different. It is unlikely that many paint companies will consider the above formulation as the last word in plaster sealers. Further variations in sealer formulation can be readily visualized by the formulator. It nevertheless represents a practical formulation which will demonstrate the good properties of Pliolite S-5 for this application.

Traffic Paint

Pliolite S-5 based traffic paint is no longer in the development stage. It has been used in the field with very gratifying results. Service results are available based on large scale application under true field conditions. It has been possible to prepare an engineering survey of a state-wide striping program. Such information as weather at time of application, traffic count, road surface, degree of surface preparation, application rate and so forth was recorded. Field photographs were taken of the original stripe and compared with service photographs taken after five to ten months of field service. It is now possible to release the findings of this study.

Formulation

The following formulation is the one observed in the large scale field striping program.

	Pounds
Medium Chrome Yellow, C. P. Nitrate Type	330
Titanium Dioxide, Anatase	65
Calcite Whiting, Low Oil, 5 to 15 microns	80
Diatomaceous Silica	140
Aluminum Stearate, Di-acid	10
Lecithin	8
Vehicle, Standard Formula	590
Pliolite S-5 Milled Resin	125
Chlorinated Paraffin, 70% Cl	65
Chlorinated Paraffin, 40% Cl	60
Toluene	170
Mineral Spirits	170
Toluene	133
Mineral Spirits, paint grade	25
	1381

As was stated beforehand, Pliolite S-5 is easily processed. This formulation, or formulations based on this particular vehicle, give rapid and easy pigment wetting and dispersion. Volume production without long grinding in pebble or ball mills may be obtained.

Another feature is the excellent suspension characteristics. Storage or shelf aging for long periods show only slight amounts of a soft settling. The formulation is extremely flexible and may be modified in several directions. For city traffic stripe, use of a faster solvent combination is suggested. Higher pigment loadings including the use of pumice and mica also may be used. The recently announced S-5 compatible BR254 tung oil varnish is another possibility. This original formula, however, has given very creditable service. It has been applied and studied under the many field conditions that follow.

Striping Procedures

The mechanics of placing a stripe are of such a nature that the variables may be controlled to quite a degree. The main points in striping operation by machine application might be as follows:

1. Method of preparing the road surface
2. Thinning and mixing of the paint
3. Operation of the spray machine
 - a. Atomize pressure
 - b. Tank pressure
 - c. Rate of travel
 - d. Nozzle and air curtain adjustment
4. Method of protecting the wet line

Other factors encountered in the field that have considerable importance in the durability of traffic paint formulations might be as follows:

1. Weather
 - a. Annual
 - b. Prior to and immediately after striping operation
2. Local soil conditions
 - a. Roadbed drainage
 - b. Abrasive particles that may be carried onto the road
3. Variance in rate of application
4. Degree of surface preparation
5. Type of surface
6. Traffic
 - a. Number and type of vehicles

- b. Width of road and location
- c. Vehicle speed

Relation of Striping Variables to Pliolite S-5

Thinning and mixing of the paint, solubility, and handling characteristics are very important as far as the striping crews are concerned. The solution characteristics of Pliolite S-5 are such that thinner, if required, is very simply added. The traffic paint formulations possess excellent suspension. Any settling that may be encountered over long storage periods is slight and soft, and may be easily put back into suspension. In the field, this means time savings in charging the spray machine. S-5 is non-oxidizing and, for this reason, insoluble hard skin cannot form. Hard skins are difficult to handle, clogging screens and making the machine cleanup time-consuming and laborious. A small amount of skinning per day

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of striping easily adds up to considerable stripe that is never used.

The operation of the spray machine may be called a standardizable variable. Atomizer-tank pressure ratios can be correlated with the machine travel to give the proper rate of application. This however, must be accomplished easily or else poorly applied stripe may result. Of all the Pliolite S-5 stripe applied in the large-scale operation, no difficulty was encountered in spraying.

Weather Effect

The weather also has considerable bearing in terms of good visible stripe. The annual conditions do not appear to have as much influence on copolymer material as it does on oleoresinous films. One of the main problems, other than snow with subsequent cinder and tire chain abrasion, is saponification or flaking on concrete surfaces. The choice of no-saponifiable Pliolite S-5 under these conditions is understandable. Many times in the field the pressure of completing a stripe rules over an approaching threatening weather condition. Thus, a formulation must not only dry to a rapid non-track traffic state, but must develop rapid weather insensitivity. The anchorage and "waterproofness" must be such that early precipitation will not cause a preferential wetting condition by the water film with subsequent loss of adhesion. It is realized that even a small amount of stripe lost by such action entails heavy replacement costs.

This condition was vividly illustrated by several test areas. Rain was encountered the day following the stripe application. No change was noted in the Pliolite S-5 based traffic paint; both other materials (conventional oleoresinous) failed badly by severe flaking and scaling.

Local Soil Conditions

Local soil conditions affect the durability, varying according to type of abrasive particles that may be carried onto the road. The studies made are not conclusive as far as this point is concerned; but did show a trend that road shoulders of a low plastic index soil, mainly siliceous in nature, affect the durability more so than high PI soils.

Application Rate

Variance in rate of application appeared to be the major durability variable related to Pliolite S-5 based traffic paints. The durability of a stripe is not likely to be directly proportional to the rate of application. Other conditions being equal, the dry time of a low rate of application is considerably less than the dry period of a high rate. If penetration and wetting into dirt-filled crevices is a function of dry time (with dry time regulated

by rate of application), it is readily apparent that a light-weight coating may not adhere at all while a heavier rate will enable fair adhesion to be obtained. Thus, film thickness regulates the amount and rate of penetration through soil films to the roadbed. This resultant anchorage in turn actually determines the durability.

The minimum recommended application rate is 18 gallons per mile of 4 inch wide stripe. Actually, rate effects have been field checked in the range of 12 to 45 gallons per mile. It was found that the low 12 gallon per mile rate would roughly give only one-third the durability of the recommended rate. The cost *versus* return ratio of the higher rate did not appear to be economically justified.

Surface Preparation

Surface preparation and the many different types of surfaces make controlled tests difficult to correlate with field service. The ideal situation is obtained when the surface to be striped does not have dirt films which will influence the adhesion of the stripe. A soil layer interferes with adhesion of the paint to solid pavement because it prevents satisfactory wetting by the paint and penetration.

Various cleaning methods have been tried and are used to overcome soil interference. The cleaning methods used are rotary power brooming and high pressure water flushing. The rotary power broom has difficulty in penetrating the small crevices and craters in the roadbed, although it has the power necessary to dislodge cakes of soil that the flushing method would have difficulty in handling. A combination of the two methods may be well suited for extremely dirty conditions or where the contamination is composed of materials that have a relatively high plastic index. However, no cleaning method is 100 per cent effective. Adhesion to the roadbed by wetting and penetration should be obtained in spite of foreign materials. Even though a film exhibits outstanding abrasion resistance under laboratory and test conditions, it must penetrate and anchor through the normal road conditions of contamination. A tough durable film may easily disappear through lack of base adhesion.

An outstanding and valuable characteristic of Pliolite S-5 based traffic paint is the ability to penetrate, wet and anchor. Stripe was applied on hundreds of miles of highways that had not received surface preparation. Dirt contamination ratings ranged from slight to very severe. Checks were obtained by the use of other traffic striping materials. Pliolite S-5 traffic paint performed remarkably well even under the most severely contaminated conditions. The adhesion was found to be excellent. Some other materials were removed by traffic in a relatively short time, primarily from a lack of adhesion.

MODERN INDUSTRIAL FINISHES AND THEIR APPLICATION

GENE L. JESSEE, The University of Houston

For a better understanding of the material to follow, it might be advantageous to define some of the more common finishes and in so doing, to touch upon the general characteristics of their many related products. These related products will be treated in detail later.

The following definitions are taken from 1948, third edition of *The National Paint Dictionary*.¹

Paint: A mechanical mixture or dispersion of pigments or powders (usually opaque) with a liquid or vehicle (sometimes termed a medium). The finished product is suitable for application to surfaces by means of brushing, spraying, roller coating or dipping, and solidifies or dries to form an adherent protective, sanitary and/or decorative coating.

Varnish: Any homogeneous transparent or translucent liquid, which when applied as a thin film, dries on exposure to air to a hard film, giving a decorative and protective coating to the surface to which it is applied.

Shellac: The purified resin obtained from various plants by the incisions of an insect, *Coccus Lacca*. It usually occurs in thin yellow-brown leaflets which are insoluble in water but soluble in alcohol. It is used extensively as a spirit varnish in polishing materials and in sealing wax.

Lacquer: The term Lacquer usually indicates the material dries by evaporation, and forms a film from the nonvolatile constituents.

Enamel: A broad classification of free-flowing pigmented varnishes, treated oils or lacquers which usually dry to a hard, glossy or semi-glossy finish. Enamel films are characterized by an absence of brush marks. The line of distinction between enamels and paints is very indefinite.

From the above definitions it is easily realized that the ultimate aim of every paint chemist is the production of a finish which will be of the highest quality in service as a protective, preserving, decorative, and beautifying coating for any desired surface. The reference to the word surface may be taken literally, as everything from the reinforcement rods used in concrete construction to the familiar kitchen sink. The paint industry is making great strides despite its handicaps of disinterest, uncooperative factions, and previous lack of support, and in so doing, it is

making life more pleasant, luxurious, sanitary, and safe.

In comparison of time spent on development of finishes used in industry and those used for domestic purposes, industry, though short-lived, has far exceeded domesticity in use of finishes which have been used domestically for thousands of years. This has been due to the manufacture of new items every day, maintenance of parts in continuous operation, research for better finishes for products, and development of finishes for articles still on the drawing board. The manufacture of a new article, a new mode of construction, or a new process sometimes brings to light a totally new set of properties to be coped with; thence the result is a totally new set of protective, preserving, decorative, and beautifying finishes.

As it would be supposed, the finish is like a compounded prescription, in that it must satisfy every need of the surface to which it is applied. These are several factors which have to be considered, other than the properties, its locational environment; general climatic conditions, such as temperature, humidity, and its operational environment; temporary contact with other moving parts, or corrosive liquids and performance standards are always to be considered. For these reasons, it is very important that the binder be carefully chosen, that the pigment be adaptable, and that the maintenance be made a minimum, and the safety and sanitary factors a maximum. Thus are seen the factors which determine the future possibilities of any finish.

The applications of modern industrial finishes are as many and varied as are the finishes themselves. Since the construction era is the giant of our age, it is only fitting that we consider it first.

The construction business has made many demands for new and improved finishes. Such things as a paint containing a binder similar to Portland cement to give a corrosive resisting coating to steel girders has been requested. A paint has been developed with a binder similar to Portland cement in that it is a mixture of tri-calcium silicate and di-calcium aluminate.

Other types of finishes which have revolutionized concrete construction are the production of paints to satisfactorily protect and waterproof cement floors and walls, as well as fireproofing wooden structures. The problem of eliminating dusting or weathering of cement floors was solved when a patent was published in which it was shown that a resinous acid in the paint would combine with any free lime that might be present and thus hinder any deterioration. With the rise

This prize-winning paper was presented before the joint meeting of the Dallas-Houston Paint and Varnish Production Clubs, April 30, 1949, for publication in the *Official Digest* of the Federation of Paint and Varnish Production Clubs and is published by their permission.

in construction of cement floors for shops and factories, there arose the problem of oily machinery. The problem of fire hazard from dried shingles was solved by the production of a fire-resistant paint containing asbestine, which is a white fibrous magnesium silicate having very inert properties.

A novel paint in use by the shipbuilding and maintenance industry is called anti-fouling or ship's bottom paint, which combines the properties of waterproofing or protection against corrosive salt water and the elimination of any adhering crustacea through poisoning pigments in the paint or through having the paint in a semi-dry condition, thus waterproofing, and at the same time depriving any otherwise adhering matter of a hard dry surface. Such a paint, containing the red oxide of mercury, is the one used by the U.S.N. and developed by naval constructor Henry Williams. His paint is recognized as having the most effective results, in that it combines both the semi-dry and poisonous properties.

With the construction of brick buildings, it became desirous to have a paint which would solve the problem of sweating walls, or in general, a damp resisting paint which was waterproof. The first such paint was produced in 1892.² Since then many improvements have been made, but the basic constituents still include white bitumen, treated China wood oil, and treated linseed oil in which the glycerine is substituted for by some metallic base. The importance of such a paint lies in the fact that it may be used as a weather sealing paint for brick walls, as a water-proofing and corrosive resistant coating for pipes, and for prime coating machinery which is operated under liquid or is liquid cooled, and as a coating to which cement will adhere. This last property has so magnified the importance and industrial development of such a paint that it has become a necessity to engineers in the priming of metallic structures which are to be covered with concrete, and in this manner prevent any electrolytic oxidation.

Wooden floor paints are much the same as concrete floor paints; the main idea being a mixture of a minimum amount of oil and a maximum amount of hard resin varnish which when dry will give a hard waterproof and glossy finished surface. Wall surfaces are usually painted with a variety of paints, commonly known as flat paint. This paint does not give a glossy finish, but retains the properties of durability and weather resistance. Flat wall paints used in the United States have as a general composition a lithopone pigment, a twenty per cent water emulsion, and small amounts of linseed oil, or for non-water containing flat paints, "a semi-fossil damar mixed with linseed oil, or more generally, a rosin China wood oil varnish containing fifty per cent of solvent"³ whose high volatility aids in giving the desired flat finish. This type of finish is the one that is universally used on plastered walls.

Extensive experimentation by paint manu-

facturers is gradually eliminating the heretofore peeling and disintegrating floor and wall paints. It has been pointed out that each kind of sizing requires its own type of finish, and most paint dealers are able to advise the consumer on his painting problems, thus giving him economy of time, effort and expense.

Perhaps the real champions of the finishes used in the construction business are the oil and varnish paints used in the protection of prefabricated houses. In the future a process for baking the finish on the sections and thereby insuring it against abrasion and making it more durable will be worked out. "The pigments used for protection, hence for covering, are white lead, zinc oxide, lithopone, blanc fixe, titanium pigments, and rouge; to these, coloring substances are added in small quantities."⁴

It would probably be well at this point to sum up the generally desired qualities strived for by the paint chemist in the development of paints, varnishes, enamels and lacquers. A paint should be fast drying; it should harden to an unbroken film; be weather resisting; have a high hiding power, have inert properties; and have a lasting finish. While an enamel is a varnish containing pigment, they are both called upon for practically the same properties, in that they should be medium drying, have a hard protective finish which may be applied in thin layers, and be capable of withstanding widely ranging environmental conditions. Lacquers are protective coatings which dry due to evaporation of volatile components and are characterized by the film forming constituents of the ethers, nitrates, or acetates of cellulose. They are faster drying than varnishes, but are inferior in luster. The three main uses for lacquers are (1) the manufacture of leather in which cotton materials is coated with a nitro cellulose solution and then embossed to give the finish a grainy leather effect; (2) the baked lacquer finishing of automobile bodies, which is protectively superior to varnishes and enamels, and (3) for interior decoration purposes such as woodwork and furniture.

"Printing inks should not be compared to ordinary inks; in the sense that they are not inks at all, but rather paints. They must dry as fast as applied, mainly through penetration of the paper."⁵ The main constituents of inks are carbon black or lamp black, rosin or linseed oil, rosin varnish and a drier. Colored inks have practically the same composition, with the addition of the desired metallic salts of organic dyes or some natural inorganic coloring salts.

Enamels are mainly used in the finishes of refrigerators, washing machines, stoves, and automobile bodies. They may be applied and let dry or they may be baked on. This latter process is coming more and more to the front as an accepted practice by automobile manufacturers.

Modern industrial finishes find many uses such as a protective coating for the iron vessels used

in fermenting processes, kitchen drains, oil cloth, handles on cooking utensils, linoleum, motor wiring and numerous household items. The future shows promise that protective finishes will always be in demand.

The investigation of the future possibilities of coal in the paint and varnish industry have opened up entirely new fields for the utilization of by-products of coal distillation. Such oily and resinous materials have and may someday completely substitute for the many imported oils and resins in use today. Synthetic drying oils from petroleum metamorphosis and cross linkage chlorination of straight chained hydrocarbons is a laboratory accomplishment, and is ready for future development. The possibilities of a building lumber which is mill primed has become practice as will the processing of a house paint that will exhibit a valve-like action, in that it will humidify and maintain a comfortable temperature inside the home by permitting inside moisture to escape, and prohibiting outside moisture from entering. It has been proposed that such a result might be obtained by the use of specially shaped particles which will exhibit a valve-like action. Mildew will disappear with the introduction of a toxic pigment in the paint which will be nontoxic for humans. It seems unlikely that any metal will ever take the place of structural steel, so greater demands for improved protective coatings will arise.

Demands such as a way to apply primers at the rolling mill, or applying metallic powders and protective pigments to the surface of the hot metal by calorization will arise. The possibilities of luminous paints used in sign making, highway signals, and road markings is a not too distant prospect. In the future, the public will be more educated in the technology and application of paints, and a deeper appreciation and a more comfortable atmosphere will be guaranteed to the homeowner who lives in a home which has been decorated in scientific color harmony. The future will see a greater use of enamels for safety purposes, a return to quick drying coatings containing new cellulose compounds, the use of aqueous dispersions instead of oils to give a paint

which might be applied to wet surfaces, the use of more rapid drying, non-volatile, quicksetting varnishes, the use of rubber as a base for acid and alkali-resistant paint, and a greater use of spray application through the development of less viscous paints.

As new and better things are developed every day by the machines of modern industry the ever expanding paint research program will match the genius of production through meeting its every demand and making life more livable.

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4. Riegel, Emil Raymond. *Industrial Chemistry*, New York, 1942, p. 570.
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NEWS AND REVIEWS

The New Products Department of American Cyanamid Company has recently published a bulletin describing physical and chemical properties of potassium cyanate. Although this product has been known for over 100 years, it has only recently been produced on a large scale.

Potassium cyanate has been used as an intermediate in synthetic chemistry and as an agricultural chemical, but it is felt that this versatile compound may find many additional applications in such fields as production of pharmaceuticals surface active agents and baths for treating metals. Copies of the bulletin are available upon written request.

* * * * *

A new edition of the basic technical booklet "Ethyl Cellulose, Properties and Uses" has recently been issued by Hercules Powder Company, manufacturers of ethyl cellulose.

The new edition contains considerable new as well as revised information about this versatile cellulose derivative which can be formulated about plastics, lacquers, varnishes, film and foil, and adhesives. Many indicated applications are suggested by the technical data contained in this booklet.

The booklet is divided into three sections: Introduction, which includes a description of ethyl cellulose's properties; Formulation, which deals with the solvents, resins, plasticizers, and other ingredients used in ethyl cellulose formulations; and Specific Applications, in which end uses for ethyl cellulose are discussed.

* * * * *

Commercial availability of a new class of resins, promising wide usefulness in the manufacture of surface coatings, is announced by Bakelite Corporation. The resins are oil modified styrene copolymer solutions and are designated as Bakelite "C-10" Resins. Two types are currently available—BJS-501 and BJS-502.

BJS-501 is particularly recommended for interior architectural finishes, such as trim and wall surfaces in homes, offices, and other buildings. Air-dry enamels of exceptionally high gloss and "build" are produced. They may be applied easily by brushing and are superior to conventional enamels in resistance to fogging in interior exposure. The resin is pale in color, promoting wide color possibilities, and, in addition, has good

color retention, good pigment suspension and stability even with reactive pigments. Mineral spirits can be used as the sole solvent.

Enamel finishes that air-dry as fast as lacquers can be made from Bakelite "C-10" Resin BJS-502. They are already being used for toys and farm implements where it is an advantage to be able to handle such items eight to ten minutes after spray application.

Baking-type enamels based on BJS-502 offer great usefulness in meeting short baking cycles. For example, enamels will bake to a Walker-Steele hardness of 137 sec. in 30 minutes at 250 deg. F. At 300 deg. F. such enamels bake to a hardness of 141 sec. in 20 minutes. BJS-502 also features good stability, suspension of pigments and color retention.

Compatibility of these resins and other pertinent data have been studied, and it is expected that products will find wide usefulness.

* * * * *

Uses for and methods of applying Rez, Monsanto Chemical Company's clear, synthetic resin sealer, are detailed in a report now available from the company.

Developed specifically as wood sealer it is claimed Rez seals wood cells against the entry of moisture by forming a hard penetrating film across the tiny apertures in the cells.

The initial synthesis of two new glycols has been announced by Carbide and Carbon Chemicals Corporation. These glycols are substituted 1,5-pentanediols: 2-methoxymethyl 2,4-dimethyl pentanediol-1,5 and 2-theoxymethyl 2,4-dimethyl pentanediol-1,5.

These pentanediols combine the chemical characteristics of glycols and glycol-ethers. The two hydroxyl groups in the 1,5 positions make them of special interest for the manufacture of maleic and other alkyd resins, plasticizers, and elastomers. The ether groups confer solubility characteristics which make them useful as coupling agents and as solvents for protective coatings, hydraulic fluids, duplicating fluids, metal cleaners, textile dyes, and adhesives.

The water solubility and low volatility of these diols suggest their use as softeners or plasticizers for casein, zien, and other water-soluble resins.

2-Methoxymethyl 2,4-dimethyl pentanediol-1,5 when used, at concentrations between 15 and 25 per cent by weight based on the total resin composition, is a plasticizer in the milling, molding, and casting of nylon resins. The finished articles possess better flexibility, increased toughness, and

higher impact resistance especially at low temperatures.

Because of the unique structure of these compounds, each is expected to assume an important place in the chemical industry.

APPLICATIONS OF CHLOROWAX TO PROTECTIVE AND DECORATIVE COATINGS*

By K. S. WADE, Diamond Alkali Company

Introduction

During the past few years chlorinated paraffins have become increasingly important in the protective coating industries and promise to expand rapidly into many fields where their unique properties and relatively low cost indicate their value. The two main products on the market are a liquid chlorinated paraffin containing 40 per cent chlorine by weight and a solid resinous chlorinated paraffin containing 70 per cent chlorine by weight. The 40 per cent material was widely used during World War II in the manufacture of fire retardant duck coatings. The development of 70 per cent chlorinated paraffin was brought about by the interest of the U. S. Navy and U. S. Army Quartermaster Depot in obtaining a product that contained more chlorine and had film-forming properties. Seventy per cent chlorinated paraffin proved to fulfill both of these requirements and many of the duck coatings made in the later stages of the war contained both 40 and 70 per cent chlorinated paraffins.

Our chlorinated paraffin containing 40 per cent chlorine by weight is called Chlorowax 40. Its color is less than 4 on the Gardner color scale, it has a specific gravity of 1.15 and a viscosity of approximately 25 poises at room temperature. It is non-toxic, is chemically inert, is insoluble in water and has an average chemical formula of $C_{24}H_{43}Cl_7$.

Our chlorinated paraffin containing 70 per cent chlorine by weight is called Chlorowax 70. It is a cream colored non-toxic resin, having a specific gravity of 1.65, insoluble in water and highly resistant to burning. It has an average chemical formula of $C_{24}H_{29}Cl_{21}$.

Both Chlorowax 40 and 70 meet the joint Army and Navy specification JAN-P-429. At room temperature, water, acids, alkalies and oxidizing agents have little effect on them. Neither of these products condenses or polymerizes. At temperatures of 275 F. and higher, dehydrochlorination occurs with the formation of unsaturated compounds and darkening of the product. This reaction appears to be autocatalytic and can be re-

tarded by the presence of acid acceptors. More will be said about stabilizers later.

The stability of chlorinated paraffins is determined by passing dry air or nitrogen through a 20 gram sample of the chlorinated paraffin maintained at 347 F. for four hours and absorbing the decomposition gases in a solution of sodium hydroxide of known strength. By titration and calculation the amount of hydrogen chloride released is determined. This test which has been described briefly is the one used by the Jeffersonville Quartermaster Depot. Obviously the lower the loss of hydrogen chloride the more stable is the chlorinated paraffin. The maximum allowable loss of hydrogen chloride for Chlorowax is one half of one per cent by weight.

Both Chlorowax 40 and 70 are soluble in a wide variety of organic solvents which include aliphatic and aromatic hydrocarbons, hydrogenated naphthas, chlorinated aliphatic and chlorinated aromatic hydrocarbons, ketones, and esters. Both are insoluble in the lower alcohols such as ethyl, isopropyl, and normal butyl alcohol but are soluble to some extent in the higher alcohols.

The most important and valuable property of both types of Chlorowax is their compatibility with a large number of diverse types of plastics, resins, plasticizers, elastomers, and waxes. This property permits their use in a large number of applications where their plasticizing action, high resistance to burning and other special properties are of value.

Uses

Alkyd Systems:

The replacement with Chlorowax 70 of as much as 25 per cent of the alkyd* solids produces a paint having lower raw material cost, better adhesion, and increased water and chemical resistance. In general, there are two effective ways of working Chlorowax 70 into the system. One is to add the dry powder to the grinding paste. When using this method, however, the Chlorowax should be added to the paste after a good portion of the pigment is wet out as immediate addition to the grinding vehicle will cause the Chlorowax to ball up. Another method is to cold cut Chlorowax 70 at high solids, and then add this cold cut to the grinding base. This latter method will produce

* This paper was presented before the following Paint and Varnish Production Clubs: Northwest, Philadelphia, Houston and Dallas, for publication in the *Official Digest* of the Federation of Paint and Varnish Production Clubs and is published by their permission.

* Medium and Long Oil Alkyds

the best gloss and the more uniform results. The method of cold cutting Chlorowax 70 and then adding the cold cut to the ground paste in the thinning process does not usually give good results since there is a very small insoluble portion in Chlorowax 70 which is difficult to disperse.

Chlorowax 70 is not a polymerized resin, therefore it tends to produce a thinner bodied paint than most alkyd resins. To correct for this thinner body we have used various bodying agents such as soap solution. Multifex MM (fine particle size calcium carbonate) and Syntex 2552.** All are effective in increasing the body of a paint containing a vehicle composed of 80 per cent alkyd—20 per cent Chlorowax 70 to that of a straight alkyd system. Two gallons of 1 per cent soap solution per hundred gallons of paint or 1 per cent Syntex 2552 based on the total weight of the paint or $\frac{3}{4}$ pounds of Multifex MM per gallon of finished paint were enough to produce the desired viscosity.

For drier combinations we recommend that the same driers be maintained and in the same amount as though the Chlorowax vehicle combination were all standard vehicle.

Can stability of alkyd Chlorowax paints containing as high as one third of the vehicle solids as Chlorowax 70 has been found to be entirely satisfactory after 18 months storage. These tests were run on red iron oxide, chrome green, and titanium dioxide paints; all three systems were satisfactory and the stormer readings were within 5 points of the original viscosity.

Baking Enamels:

A baking enamel based on 20 per cent Chlorowax 70 and 80 per cent alkyd resin as the vehicle will produce a film with higher gloss, and better adhesion than a straight alkyd system. These same improvements are still apparent after 300 hours National Carbon Weatherometer exposure. Without stabilizers 270 F. is the maximum baking temperature for Chlorowax 70. It begins to decompose at 275 F. with the release of hydrogen chloride gas. With this chemical breakdown, discoloration occurs and a very brittle film results. However, with suit-

able stabilizers such as tribasic lead maleate monohydrate,* Chlorowax 70 can be held at 350 F. for 20 minutes in a baking enamel without decomposition. In this study 3 per cent of the stabilizer was used based on Chlorowax 70 solids. Chlorowax 70 tends to show a very slight yellowish discoloration in these systems, but bleaches out on aging in the presence of light.

Chlorowax 70 Emulsion:

Chlorowax 70 can be emulsified both with and without volatile solvents. One means of emulsifying Chlorowax 70 without a volatile solvent is to dissolve it in linseed oil, another is to dissolve it in liquid chlorinated paraffin. A formula for an emulsion of this type is as follows:

* Trade Name TRI-MAL manufactured by National Lead Company.

Roller¹ Spray² Dip³ Coatings
BEETLE* 216-8 or MELMAC* 247-10

For improved stability and compatibility, use BEETLE 216-8 or MELMAC 247-10 with varnishes, REZYL* resins or CYCOPOL** resins. Why not get the right resin combination for every baking finish? Technical information available.



AMERICAN Cyanamid COMPANY

COATING RESINS DEPARTMENT
30 Rockefeller Plaza • New York 20, N. Y.

** Jones-Dabney Company

***Trademark

	Pounds
Chlorowax 70	245
Alkali refined linseed oil	455
Triethanolamine	26
Oleic acid	79
Water	635

The emulsion is prepared by dissolving Chlorowax 70 in linseed oil with the aid of heat and then adding the remaining ingredients slowly with the aid of a high speed mixer. The emulsification should be carried out at 85 C. This type emulsion is of interest in water reducible paints and more specifically in water reducible fire retardant paints.

Dispersions:

A stable dispersion of Chlorowax 70 can be prepared by pebble milling 50 pounds of Chlorowax 70, 1 pound of polyvinyl alcohol** and 49 pounds of water for 24 hours. This produces a smooth, thixotropic dispersion which can be diluted with water without breaking. This dispersion is of interest in making flame retardant paper.

Fire Retardant Paints:

Our previous work on fire retardant paints has been reported in the July, 1948 issue of the *Official Digest* and will not be repeated here. However, we have done additional work on producing a fire-retardant flat based on barium sulfate and Chlorowax 70 as the main fire retardant ingredients. Briefly, a paint having good fire retardant properties can be produced in which a minimum of 30 per cent of the vehicle solids is Chlorowax 70 and which contains four pounds of barium sulfate per gallon of finished paint. The pigment to binder ratio of this paint is 1.5 to 1.0 by volume. This paint is equal in fire retardant properties to one containing antimony oxide and Chlorowax 70 at the same pigment binder ratio. The barium sulfate combination is considerably cheaper than the antimony oxide formulation, and has several other advantages.

Formulating semigloss and gloss fire retardant paints is much more difficult and we have not been able to produce these types of paint, even using

Chlorowax 70, antimony oxide, barium sulfate and other fire retardant agents. In conducting our tests on various vehicles we have found that alkyd resins gave the best results as the normal vehicle, oleo resinous vehicles were second in effectiveness and oils were found to be the poorest of all as fire retardant vehicle.

One method of testing fire retardancy of paints that we have used is as follows: Number 1 cedar shingles 5 inches wide and 16 inches long were selected as test panels. An area 3 by 16 inches long was painted (by brush) leaving an area 2 by 16 inches uncoated. One and two coat systems were prepared and then the panels were allowed to air dry 30 days. At the end of this period the panels were tested for fire retardancy by the following procedure:

The test shingle was held in a vertical position by means of clamps with the thin end of the shingle as the bottom edge. Next a lighted bunsen

Now!

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NEVILLE

LX 685 RESIN



SPECIFICATIONS

(Shelving Paint)
(Coke-to-Mercury).....110-120°C
Color:
Haze, (Neville Method).....2-4
40% solution in mineral spirits
(Gardner Method).....14
Acid No.....less than 1
Saponification No.....0
Boiling No.....100 to 110
Av. Sp. Gr. at 25° C.....1.122
Av. wt. per gal.....9.35 lbs.

VARNISH CHARACTERISTICS

- Fast Drying
- Good Light Stability
- Excellent Resistance to acids, alcohols, alkalis, gasoline, grease, water

gives you an unusual opportunity to cook better varnishes for the manufacture of Floor and Concrete Paints, Porch and Deck Enamel, Metal Primers, Gasoline and Grease-Proof Coatings, Chassis Blacks and Fast Drying Aluminum Paints. And you can do it at less cost!

Neville LX 685 is a neutral, unsaponifiable and heat reactive resin. Its unique drying influence on drying oils makes it possible to use appreciable amounts of the more economical Soya Bean Oil, with practically no sacrifice in final dry, and inexpensive mineral spirits may be used as the entire solvent.

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(in drums of 450 lbs., F.O.B. Pittsburgh)

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RESINITE 2-30-100 FLASH • CRUDE & REFINED COAL-TAR • WAX EMULSION THINNERS
SPECIALTIES: PHENOTHALENE • RUBBER COMPOUNDING MATERIALS • TAC PAINTS

Chemicals for the Nation's Vital Industries

** Elvanol 72-51 made by E. I. du Pont de Nemours Co., Inc.

burner with a two inch blue cone flame was placed under the uncoated edge of the test shingle. With this flame the tip of the bunsen burner just touched the shingle and was left under the shingle for thirty seconds. This sets the uncoated area of the shingle on fire so that it is completely destroyed but if the coated area has been painted with good fire-retardant paint the fire will not penetrate into this area at all but will stop right at the line of demarcation.

This is a good preliminary test and should be followed by a more severe test such as the New York Production Club Cabinet Test, the Schlyter test or some other severe test.

Exterior Fire Retardant Paints:

Fire retardant exterior paints have been formulated in which Chlorowax 70 replaces linseed oil solids in the amount of 35 to 50 per cent by weight. The formulas include one pound of antimony oxide per gallon and a weight of pure calcium carbonate equal to the weight of Chlorowax 70 used. The recommended grinding procedure here is to include the Chlorowax 70 in the grinding paste. Twelve months Florida exposure tests indicate the formulas so revised have a noticeably decreased chalking tendency with some dirt collection but no abnormal film failures. However, it is too early to say what the life of this type paint will be but indications are that it will conform to the generally accepted standard house paints for durability and re-coatability.

Clear Fire Retardant Coatings:

Chlorowax 70 can be used to produce a clear protective coating that will not burn. For instance, a combination of 40 per cent cumarone indene resin and 60 per cent Chlorowax 70 has been found very effective. This coating can be used over wood impregnated with water soluble fire retardant salts, thus preventing leaching of the fire retardant salts and also providing a non-flammable surface coating. Also, wood may be coated with Chlorowax 70 solution alone as a means of keeping soluble fire retardant salts from leaching out.

Chlorowax 70 in Printing Inks:

In printing inks, Chlorowax 70 shows some of the properties normally attributed to resin and wax combinations. As a resin, it can be utilized as a substitution agent in the formulation of alkyd resin ink varnishes. It is possible to substitute Chlorowax 70 for 25 per cent of the alkyd solids without impairing the binding properties or decreasing the setting speed, with of course a substantial lowering of material cost. Because Chlorowax 70 is neutral it is successfully employed in metallic varnishes alone or in combination with other resins depending upon the viscosity desired. Chlorowax 70 metallic ink vehicles contribute to good leafing and masstone brilliancy as well as non-tarnishing tendency.

Chlorowax 70 can be added in dry form to

various ink formulations with interesting results. The usual three passes on a 3 roller mill are sufficient to disperse the Chlorowax 70 throughout the ink system. Amounts up to 5 per cent by weight have been added to produce positive effects. In gloss carton inks, for example, it is necessary to maintain a high gloss as well as optimum slip or rub-proofness. Vegetable or mineral wax will detract from the gloss and will shorten the ink body considerably. These latter effects can be prevented by incorporating amounts up to 5 per cent by weight of Chlorowax 70 into the formula. Chlorowax 70 will not detract from the gloss, will contribute to the slip, and if a very small percentage of wax is retained, give good length and flow properties with improved printability. Another contribution of Chlorowax 70 is in heat-set ink formulations. Here, small percentages of Chlorowax 70 will improve the printability of the inks and produce a sheen or finish to what would otherwise be a flat ink surface. Chlorowax 70 does not inhibit the solvent release or affect press stability of the heat-set inks.

Chlorowax 40 Applications

Our liquid chlorinated paraffin, Chlorowax 40, is primarily a plasticizer and is of such quality as to make it suitable for general use.

Nitrocellulose Furniture Finishes:

Chlorowax 40 has usefulness as a plasticizer in furniture lacquers. It has been found that it can be used in place of castor oil, or soya or even in some cases as a partial or complete replacement for the generally accepted primary plasticizers. A typical formulation is:

*Formulation No. 1 Formulation No. 2
Parts by weight Solid Basis*

1/2 Sec. Nitrocellulose	100	100
Non-oxidizing alkyd resin	100	100
Maleic resin	50	50
Dibutyl Phthalate	20	20
Castor Oil	20	..
Chlorowax 40	..	20

The Chlorowax 40 formulation has proved to be equal to the standard formulation in every way including good cold check resistance.

Colored Lacquer Enamels:

Chlorowax 40 shows promise also as a plasticizer for automotive lacquer enamels consisting of a combination of cotton and non-drying resins. Colored lacquer enamel panels having 250 hours National Carbon Weatherometer exposure and print tests at 40 grams per square inch indicate that it is fully equal to other well accepted plasticizers for drying, hardness, gloss, and polishing properties. These lacquers were formulated using six parts by weight of non-drying alkyd and two parts by weight of nitrocellulose, plus one part by weight of Chlorowax 40.

Of particular interest were the panels tested in the Weatherometer where Chlorowax 40 shows

definitely superior color retention. Flexibility of all films is entirely satisfactory.

Ethyl Cellulose:

Chlorowax 40 is useful as a plasticizer for ethyl cellulose and a formulation containing 75 per cent ethyl cellulose and 25 per cent Chlorowax 40 by weight will produce a clear film indicating compatibility even at this high ratio. Gloss is equal to that produced by the usual plasticizer and mutually miscible components will aid or extend the compatibility range.

Chlorowax 40 as a Secondary Plasticizer for Polyvinyl Chloride Compounds:

The scarcity of plasticizers for all types of plastics has plagued the industry for a long time. One of the principal reasons for the shortage is the fact that all efficient plasticizers are made from raw materials that are in limited supply. An attractive way to relieve this situation is to use a secondary plasticizer that is made from raw materials readily available. Chlorowax 40 is such a material.

Chlorowax 40 is miscible with the well-established plasticizers such as tricresyl phosphate, dibutyl phthalate, dioctyl phthalate, and Santicizer B-16. Combinations of Chlorowax 40 with these plasticizers are compatible with polyvinyl chloride copolymers. Mixtures of Chlorowax 40 and these plasticizers can be made which satisfactorily plasticize these copolymers and also improve several of their physical properties.

Experimental work with systems of Chlorowax 40 and the four plasticizers enumerated above has given some very interesting and valuable results. It has been found possible to replace as much as 50 per cent of these primary plasticizers with Chlorowax 40. Molded sheets of Vinylite VYNW have the following properties in comparison to those of molded sheets plasticized with the primary plasticizers alone.

1. Improved tear strength.
2. Higher 100 per cent modulus.
3. Equal tensile strength.

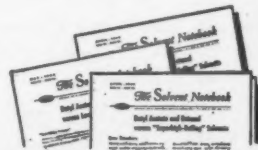
4. Equal ultimate elongation.
5. Decreased water absorption.
6. Improved heat stability when heated to 150 C. for four hours as shown by
 - a. Less loss in weight, i.e., less volatility of plasticizer.
 - b. Decreased area shrinkage.
 - c. Smaller increase in hardness.
 - d. No greater color change.
7. Easy processing by milling and molding.
8. Improved flame resistance.
9. Lower cost.
10. Some loss in low temperature flexibility.
11. Slight exudation or sweating.

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This is eliminated at 35 per cent Chlorowax 40 replacement and also in filled materials.

These conclusions are based on experimental work done in our laboratory as described below. Molded sheets were made containing 300 parts of VYNW, 150 parts of the primary plasticizer, 5 parts of basic lead carbonate and 5 parts of calcium stearate. The hardness (Durometer A) of the sheets was determined for each plasticizer, and the sheets containing the mixed plasticizers were adjusted to have the same hardness as those for each respective primary plasticizer.

In passing, it should be noted that Chlorowax 70 can be used as an extender for polyvinyl chloride in some applications. Usually a 10 per cent extension is possible without changing the over-all physical characteristics of the plastic too greatly. Also, some plasticizing action will be obtained from Chlorowax 70 in polyvinyl chloride compounds.

Stabilizers for Chlorowax 40 and 70:

In applications in the range of 275 F. to 350 F. it is necessary to stabilize Chlorowax. A list of effective stabilizers follows:

Stabilizer	Per cent Stabilizer for Chlorowax 70	Per cent Stabilizer for Chlorowax 40
Phenoxy Propylene Oxide ^{1,2}	4.0	2.0
Tri-Mal ³	4.0	4.0
Paraplex AP63 ⁴	4.0	4.0
Dibutyl Tin Maleate ⁵	4.0	4.0

¹ Carbide & Carbon Chemicals Corp.

² Shell Chemical Company.

³ National Lead Company.

⁴ Rohm & Haas Company, Resinous Products Division.

⁵ Metal & Thermit Company.

It should be remembered that the stabilization of Chlorowax can be interfered with by other materials or unusual conditions and the stabilizers may not always be as effective as the above table would indicate.

Organosols and Plasticsols:

It has been found that Chlorowax 40 can be used as a secondary plasticizer in organosols and plasticsols. Approximately 35 per cent of the total plasticizer combination can be Chlorowax 40 and films so plasticized are tough, flexible and free from pin holes. The Chlorowax 40 combinations do not produce films quite as flexible as those plasticized entirely with primary plasticizers, however, and tend to produce higher viscosity pastes. This difference is not too great when using 35 per cent of the plasticizer combination as Chlorowax 40.

Rubber Base Paints:

Both Chlorowax 40 and 70 are being used in rubber-base paints. Chlorowax 40 is used as the plasticizer and its advantages are compatibility, permanency, good plasticizing action, and low cost. Chlorowax 70 is used as an extender for the rubber resin and again lowers the formulation raw material cost. Other advantages imparted to the formulations by the use of Chlorowax are water resistance, acid resistance, alkali resistance, and good adhesion. One example of this type paint is the special traffic paint developed by the Texas State Highway Department. The complete vehicle of this paint on a solids basis consists of 50 per cent rubber resin, 26 per cent Chlorowax 70 and 25 per cent Chlorowax 40.

FOREIGN PATENT DEVELOPMENTS

REACTION PRODUCTS OF DRYING OILS AND COPOLYMERS OF CYCLOPENTADIENE AND STYRENE. The Resinous Products and Chemical Co. Brit. Pat. 614,532. Applied for July 19, 1946 (applied for in U. S. Nov. 30, 1945); accepted Dec. 16, 1948. Copolymers of styrene and cyclopentadiene (patented in Brit. Pat. 614,533) are heated in solution with a drying oil (e.g. linseed oil, bodied linseed oil, tung oil, poppy seed oil, perilla oil, oiticica oil, sunflower oil or dehydrated castor oil) until the mixture remains clear when cooled. These mixtures may be air-dried or force-dried to films or coatings which are hard, adherent, chemically resistant and flexible.

PRODUCTION OF TITANIUM PIGMENTS. Fabriques de Produits Chimiques de Thann et de Mulhouse. French Pat. 863,766. Applied for Sept. 27, 1939; delivre Jan. 6, 1941. A process for producing titanium dioxide pigments in the rutile form by hydrolyzing a solution of titanium dioxide in sulfuric acid, using as "germs" an oxide

or hydrate of titanium which has been freed of impurities which interfere with peptization and which have been peptized with a strong acid such as sulfuric acid. In place of the oxide or hydrate of titanium, an oxide or a hydrate of another metal in the fourth group of the periodic table (e.g. tin) may be used. The peptized germs or nuclei can be first coagulated, e.g. by alkali, then carefully washed free of electrolytes and used in the form of a sol or gel.

LACQUER OR VARNISH. I. G. Farbenindustrie Aktiengesellschaft. French Pat. 865,483. Applied for May 8, 1940; delivre Feb. 24, 1941. Solutions of phenol-formaldehyde resins to be used as lacquers or varnishes are increased in stability by the addition of 10 to 20% of a resin formed by the reaction of methylol-urea with acetylene. Shelf-life of the stabilized compositions is claimed to be 6 to 8 months.

PROCESS FOR IMPROVING DRYING OILS. I. G. Farbenindustrie Aktiengesellschaft. French Pat. 883,646. Applied for June 29, 1942; (applied

for in Germany Sept. 7, 1940); delivre Mar. 29, 1943. Natural, unsaturated drying oils are improved in various ways by reacting them with a poly-alcohol (e.g. glycerol, pentaerythritol, trimethylolthane) and then the product, which still contains free hydroxyl groups, is reacted with a mono- or di-isocyanate. In an example, linseed oil is heated with glycerol, and the product is then reacted with chlorophenylene-2, 4-di-isocyanate.

UREA-FORMALDEHYDE RESINOUS MATERIALS. J. D. Morgan (assigned to British Resinous Products Ltd.). Brit. Pat. 620,412. Applied for July 18, 1946; accepted March 24, 1949. A craze-resistant urea-formaldehyde resinous material is made by the condensation of formaldehyde and a ketone (e.g. acetone) in the presence of heat and an alkaline catalyst, vacuum distilled until the product attains a viscosity of 30 poises at 25° C., and the product is then incorporated with a pre-formed urea-formaldehyde type resin. The finished composition is used for non-crazing coating compositions, adhesives, molding compositions and gap-filling glues.

PHENOL-FORMALDEHYDE COATING COMPOSITIONS. Heresite & Chemical Co. Brit. Pat. 620,565. Applied for Dec. 27, 1944 (applied for in U. S. April 22, 1944); accepted Mar. 28, 1949. An improved process for producing coating compositions involves reacting phenol and formaldehyde to form an oil-free A stage phenol-formaldehyde resin in the presence of an alkaline catalyst and 5 to 30% of a volatile plasticizer from the group comprising glycols, glycerine, camphor, camphor oil, organic phosphates (e.g. tricresyl phosphate) and glyceryl triacetate. This resin is dissolved in a volatile solvent to form a solution which may be used to coat various objects. Setting consists of heating to evaporate volatile solvent followed by further heating to convert the A stage resin to a C stage resin.

HEAT-HARDENING COATING COMPOSITION. L. E. Wakeford, F. Armitage and D. H. Hewitt (assigned to Lewis Berger & Sons). Brit. Pat. 615,802. Applied for Aug. 8, 1946; accepted Jan. 12, 1949. A coating composition is made by combining (1) a hydrocarbon-soluble thermosetting condensation product of formaldehyde with a urea compound (urea, thiourea or their substituted compounds) or with a polyazine, with (2) an interpolymers of an aromatic vinyl hydrocarbon (e.g. styrene) with one or more partially polymerized polyhydric alcohol mixed esters containing a substantial portion of unsaturated fatty acid radicals. Examples of the latter include esters of glycerol, sorbitol, pentaerythritol or mannitol with drying oil acids, acids of semidrying or non-drying oils, or of rosin or copal. These acids may be replaced in part by maleic or phthalic acids or their anhydrides.

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RECENT ADVANCES IN PAINT TECHNOLOGY

ALKYDS IN PRINTING INK. After discussing the types of alkyd resins generally, the authors take up in detail various modified rosin alkyds, phthalic alkyd resins, functionality in resin formation, polyfunctional acids for alkyds, polyfunctional alcohols for alkyds, fatty acids for alkyds and the chemistry of each of various examples of these classes. This is part I of a two-part article. H. F. Payne, L. E. Caldwell, R. H. Brailey and A. F. Schmutzler. *Am. Ink Maker*, **25**, No. 12, 23-27, 51 (Dec., 1947).

PETROLEUM DRYING OILS FOR INKS. Several recently available petroleum drying oils (containing two or more unsaturated double bonds) are described as to physical and chemical properties, and their utility in drying oil combinations with linseed oil are touched upon. F. J. Smith and R. J. Lee. *Am. Ink Maker*, **25**, No. 12, 29, 31, 33 (Dec., 1947).

DIELECTRICS AND RHEOLOGY OF NON-AQUEOUS SUSPENSIONS. Results of this investigation show that from dielectric data a form factor could be established which would be a constant for each pigment, indicating the degree of deviation of the particle shape from the spherical form. Study of the phenomenon of thixotropy by the dielectric method also indicated promising results. With bodied vegetable oils, it was shown likely that these polymerized oils are not homogeneous liquids, but colloidal dispersions of insoluble higher polymers in the lower polymeric liquid. A. Voet. *Am. Ink Maker* **25**, No. 12, 34, 41 (Dec., 1947).

EVALUATION OF DRYING OILS: POSSIBLE ALTERNATIVES TO LINSEED OIL. A study was made to secure prospective alternatives to linseed oil. The oils were evaluated based upon drying properties which are assumed to depend upon the component acids. Thus, the component glycerides and acids were determined for several oils of drying and non-drying types, and these results are tabulated. Indices of drying power for the various drying and semi-drying oils were determined. General considerations to be borne in mind in the selection of a practical alternative to linseed oil are reviewed. Of the oils considered, lumbang (candlenut) and rubber seed oils are thought to be the best possibilities, but shortage of supplies without further development precludes their wholesale use as a replacement for linseed oil at present. Sixteen references and several pages of discussion following the paper. T. P. Hilditch. *J. Oil & Colour Chemists Assoc.* **31**, 1-24 (Jan., 1948).

INSECTICIDAL SURFACE COATINGS. The literature on surface coatings containing DDT is reviewed and a testing procedure described. Tables are given showing the insecticidal effectiveness of DDT in various coating vehicles on

houseflies, the effects of concentration of insecticide in urea-formaldehyde coatings and of time of contact in insecticidal coating on knockdown of houseflies, effect of inert pigment on insecticidal effectiveness of surface coatings, effectiveness of pigmented coatings employing urea-formaldehyde resin as the vehicle and DDT as the toxicant, and the influence of plasticizers on the insecticidal effectiveness of these coatings. S. S. Block. *Soap and Sanitary Chemicals*, **24**, No. 2, 138-141, 171 (Feb., 1948).

EMULSIONS AND THEIR APPLICATION IN THE PAINT INDUSTRY. The author discusses briefly the properties and theory of emulsions in general, and then takes up the subject in respect to paints. Requirements of good paint emulsions are outlined, and the conventional formulations and procedures for producing paint emulsions are discussed. Testing methods are given. Other emulsion paints such as wool grease emulsions, bitumen emulsions, continuous phase emulsion paints, vinyl compound polymer emulsions and water-in-oil emulsions are also discussed. A. E. G. Brown, *Oil & Colour Trades J.* **113**, 138, 140, 142, 144, 146 (Jan. 16, 1948).

ALKYD RESINS. The theory, nature and kinetics of the reaction of pentaerythritol and dibasic acids are discussed. The nature and physical changes during the reaction, the molecular size and structure of the products, the correlation between properties and structure of the polymer, the preparation of high-purity materials and the adaptation of the Kienle apparatus used for the kinetic studies are also discussed. Twenty-four references. G. R. Cornish. *Chemistry & Industry* 1948, 39-42 (Jan., 17th).

STYRENE COPOLYMERS. A discussion of ways to control the reaction and the reaction mechanism involved in the copolymerization of styrene with oils such as mixed esters of drying oil fatty acids (oil-modified alkyds based on one or more dibasic acids and one or more polyhydric alcohols). F. Armitage, D. H. Hewitt and J. J. Sleightholm. *Oil & Colour Trades J.* **113**, 249 (1948).

FLAME-SPRAYED PLASTICS. A brief survey of the properties and applications of polythene coatings and abrasion-resistant Thiokol coatings. W. H. Greenwood. *Chemical Trade J. and Chemical Engineer*, **122**, 217-8 (1948).

TESTING OF COATINGS ON COLLAPSIBLE TUBES. Methods of rating the performance of coatings, inks and enamels of collapsible tubes under simulated conditions of consumer use include evaluations of the adhesion and flexibility of the coatings (using a crushing apparatus), and a soap immersion test. The tests are described and sample ratings given. M. Schor. *Modern Packaging*, **21**, No. 6, 148-151 (Feb., 1948).



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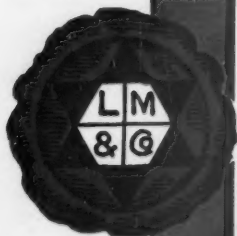
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